The present claim 1 has been amended to specify that the casing centraliser has the additional feature of unitary construction, as previously claimed in claim 5, now cancelled.

Applicant respectfully points out that the only examples of plastic centralisers relate to centralisers for use *inside* the casing i.e. on sucker rods etc as shown in Sudol, or on the production tubing as shown in Evans. The device of Seabourne also abuts against the inner surface of the wellbore casing or other tubular. These devices are not casing centralisers, as required by the present claim 1.

In contrast, the only examples of unitary casing centralisers in GB 2282615 (UWG) and US 4984633 (Langer) do not contemplate using plastics etc. as a material of construction as required by the claims. Note specifically that lines 7 to 9 of GB 2282615 states that such centralisers "... are usually of cast aluminium alloy construction, though they may be made from steel." Later on in GB 2282615, the particular centraliser described therein is stated as comprising "a cast aluminium alloy body 10" (see page 7 line 12). The Langer/Weatherford centraliser is also known to be of cast aluminium. The Barron centraliser is made from zinc alloy.

Casing centralisers are mainly used when installing a casing string into a newly-drilled borehole. As discussed in the introduction to GB2282615 and in the introduction to Barron, casing centralisers normally fit around the outside of the casing string and have the very important function of spacing the casing string from the borehole wall after insertion, which creates a space to be

filled with cement. After the string has been inserted into the well, the cement is pumped downwards through the inside of the casing, and is forced out of the end of the casing string and back up the annulus between the inside of the borehole wall and the outer surface of the casing. It is important that there is an even distribution of cement around the casing when the cement job has been completed.

Casing centralisers need to be more robust than other centralisers. If the casing centraliser fails during insertion of the casing string due to the enormous shear forces that are placed on it when a 20km casing string is pushed into a well, or by lodging immovably between the string and the borehole wall during insertion, the whole casing string can be stuck in the hole. This sometimes happens in the art and remedial work to remove or drill through the stuck string is catastrophic to the economic viability of a well, and can render a well virtually useless.

Even worse, a casing centraliser might fail once a casing string was inserted and before a cement job was completed. Such failure might not be discovered until the cement had set and could affect the integrity of the cement job. The costs of remedial action in such a case would be almost unthinkable in the case of some difficult wells.

Running the casing string into a typical well might take from 18 to 24 hours, and after cleaning the well and the casing string with various chemicals such as drilling mud and preflush etc it can be 30 to 36 hours before cement can be injected through the casing string and emerge from the bottom of

the string to pass up the annulus between the outside of the string and the wellbore. The cement can take from 12 to 24 hours to dry. If a centraliser fails during this 60 to 72 hour period then the cement job will be compromised, and the value of the well substantially reduced.

For these reasons, centralisers have traditionally been "over built" to have great reliability, because the potential failure of a centraliser in use can have catastrophic consequences for the viability of an oil well. It may be virtually impossible to replace a failed casing centraliser, and the prospect of removing a casing string after a cement job has dried is virtually unthinkable.

In contrast, to this overbuilding of casing centralisers, all of the non-casing centralisers used for sucker rods, wellhead guides and production tubing etc are generally rather temporary items which, if they fail, can simply be replaced by removing the sucker rod etc and replacing the centraliser in a comparatively simple intervention operation lasting a very short time and having no serious implications for the viability of the well other than the minutes or hours spent replacing the centraliser. These kinds of centraliser can be constructed to a fairly basic level because they can be changed fairly easily when damaged. As a result, costs can be cut in such centralisers, and they do not need to be of a particularly robust design.

Therefore, if anything, the prior art shows a consistent bias towards using *only* traditional and tested metals such as cast aluminium alloy and steel etc in the manufacture of casing centralisers, and this blinkered approach

clearly obviates the introduction of any new materials (and particularly plastics etc) in casing centralisers.

There is a further problem with the proposition that using plastics etc for unitary casing centralisers is an obvious step. Oil wells can typically rise to temperatures of 200 to 250°C. The deeper the well the higher the temperature. Therefore, the prospect of, say, a plastic centraliser remaining unaffected in a 20km-deep oil well for 60 to 72 hours at 200 to 250 °C while waiting for cement to dry is something that most skilled cement job operators would not contemplate, since there would be a high risk of the plastic centraliser melting in place or otherwise failing before the cement had dried, thereby compromising the cement job, and ruining the well. A cement job operator would therefore never contemplate using unitary plastic centralisers.

While plastics and rubber etc have been used in centralisers of multi-part construction, those plastic parts have always been reinforced with metal components in order to ensure that they are sufficiently robust to withstand the extreme conditions encountered in use (e.g. see the reinforcing rings described by Evans.)

Obviousness – 35 U.S.C §103(a)

To establish a *prima facie* case of obviousness there must be

1 some suggestion or incentive that would have motivated the skilled artisan to modify the reference to obtain the claimed invention *In re Fine*, 837 F.2d 1071,5 USPQ2d 1596,

2 a reasonable expectation that the modification would succeed *Amgen, Inc v. Churgai Pharm. Co.*, 927 F.2d 1200,1209, 18 USPQ2d 1016, 1023 (Fed, Cir. 1991); and

3 a teaching or suggestion in the prior art (not the applicant's disclosure) of all the limitation of the claims *In re Vaeck*, 947 F.2d 488, 493, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991).

In order to fulfil the first requirement of a *prima facie* case of obviousness it must be shown that there is an incentive to modify the Langer centraliser to make it entirely from plastics etc. instead of from Aluminium. Applicant respectfully submits that there is no motivation to modify the Langer reference to introduce the feature of the plastic, elastomeric or rubber material. Such a modification would not be considered for a casing centraliser by a skilled completion engineer because there is a tendency in the art of casing centralisers of adopting only tried and tested materials in the production of casing centralisers because of the extreme difficulty and expense of remedial action in the event of failure of the casing centraliser through breakage as a result of the high shear forces applied to the centraliser during insertion, or through heat or

chemical degradation as a result of the down hole conditions encountered before the cement has hardened.

Therefore, even if a completion engineer were tempted to use plastics in a centraliser, he would not do so in a centraliser of unitary construction, and would feel the need to reinforce any plastics item with metal bars etc. in order to safeguard against failure in use.

The enormous cost and difficulty of remedial actions to correct poor completion jobs means that absolutely no risk would be taken in the choice of casing centraliser, and for that reason casing centraliser design has generally tended to be extremely conservative, so that conventional casing centralisers generally tend to be over-engineered in order to withstand the worst possible conditions, very high shear strength, high temperature, high resistance to chemicals and high wear resistance. In view of the huge sums involved in remedial work to repair a cement job that fails, the selection of designs of casing centraliser for commercial use by the contracting completion engineer responsible for the cement job has been affected by the possibility of a completion engineer wrecking an operator-client's well with product failure. This reinforces the applicant's contention that the completion engineer would be motivated <u>to avoid</u> adopting a moulded (unitary) plastic centraliser in case he was liable for the failure of the cement job. He would be more likely to use a metal that would be more predictable with regard to heat resistance and shear strength etc.

Therefore, the present invention is not an obvious development from the prior art cited because a skilled person seeking to design a casing centraliser manufactured in a single unitary piece for use in hostile environments downhole would reject plastics as a viable option.

In addition to a lack of motivation to modify the Langer device to make it wholly from plastics etc, there would therefore be no expectation of success with the modified device. Although it is accepted that certain casing centralisers have some plastic components, to construct a single unitary centraliser e.g. by moulding it from plastics or similar material would require the unitary plastics device to exhibit all of the characteristics required by a centraliser as listed above. If it was obvious to produce a unitary centraliser out of plastics etc. as the Examiner suggests, the skilled man would need to bear in mind the moulding characteristics (i.e. how easy was it to mould the plastics material in the desired shape) in addition to all of the physical characteristics that are required in the assembled centraliser such as shear strength, friction co-efficient, chemical resistance etc. that might not be consistent between the formed centraliser and the raw material before moulding. There is far more that pushes that skilled person towards a choice of metals as a raw material rather than plastics etc. Any consideration of using e.g. plastics as the material of the centraliser would therefore be rejected because the skilled person would consider that it would be too difficult to find a plastics material that fulfilled all of the criteria. It may well be possible to design certain components of the centraliser from plastics material if that component only requires to have good frictional co-efficients, such as the sleeves in the Exxon document GB 2249333. However, a

unitary centraliser designed of a material chosen for its frictional co-efficient might not be suitable from the point of view of its ability to withstand shear or its ability to be moulded in a single unitary piece. Given that there is so much prejudice in the art towards tried and tested metal the designer seeking to construct a novel design of unitary casing centraliser would simply select a different metal that did not have these problems, and had a better chance of success.

Construction of the centraliser of the present invention from plastics or similar such materials as specified in the present claim has the advantage that no assembly of the centraliser is required after casting or moulding the centraliser as a unitary item, and therefore construction times and costs can be cut while ensuring that faults arising due to the assembly of a multi-part centraliser such as the Exxon device can be avoided. In addition, the centralisers of the invention are very much lighter than their metallic counterparts, and the whole centraliser behaves uniformly in terms of chemical resistance etc. This predictable behaviour is of great benefit when the centraliser is in use in a hostile downhole environment, because it can be trusted not to fail unlike other multi-partite and complex designs such as are shown in the cited documents.

As further evidence of the inventiveness of the present claims, we are submitting herewith evidence of patentability in the form of a copy letter filed on the corresponding UK patent, now granted. The letter from Devol

Engineering Limited, a plastics engineering company attests to the fact that plastics is not the automatic first choice of material for a casing centraliser.

CONCLUSION

It is respectfully submitted that the present response has answered all of the objections raised by the office action, and favorable reconsideration of the present claims is respectfully requested.

Respectfully submitted,

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